Exemption No. 6148

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
RENTON, WASHINGTON 98055-4056

In the matter of the petition of **Boeing Commercial Airplane Group** for an exemption from §§ 25.562(c)(5) and 25.785(a) of the Federal Aviation Regulations	**Regulatory Docket No. 28066**

DENIAL OF EXEMPTION

By letter B-TOAU-95-046 dated January 25, 1995, Timothy E. Hickcox, Manager, Certification 777 Division, Boeing Commercial Airplane Group, P.O. Box 3707, Seattle, WA 98124-2207, petitioned for an exemption from the Head Injury Criterion (HIC) of § 25.562(c)(5) of the Federal Aviation Regulations (FAR), for economy class, front row seating in Boeing Model 777-200 airplanes, until such time as design solutions are available.

Section of the FAR affected:

Section 25.562(c)(5) requires that each occupant must be protected from serious head injury under the conditions prescribed in paragraph (b) of this section. Where head contact with seats or other structure can occur, protection must be provided so that the head impact does not exceed a Head Impact Criterion (HIC) of 1,000 units. The level of HIC is defined by the equation:

$$HIC = \left[(t_2 - t_1) \left[\frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} a(t)\, dt \right]^{2.5} \right]_{max}$$

Related Section of the FAR:

Section 25.785(a) (currently § 25.785(b)) requires that each seat, berth, safety belt, harness, and adjacent part of the airplane at each station designated as occupiable during takeoff and landing must be designed so that a person making proper use of those facilities will not suffer serious injury in an emergency landing as a result of inertia forces specified in §§ 25.561 and 25.562.

The petitioner's supportive information is as follows:

"Boeing petitions for temporary exemption from [§§ 25.562(c)(5) and 25.785(a)] for front row economy class passenger seats. Front row economy class seats are defined as those seats located immediately aft of airplane interior features such as galleys, lavatories, closets, partitions, class dividers, and escape slide bustles, and having 40 inch or less distance from seat reference point to interior feature. Temporary relief is requested with respect to potential occupant head contact with these interior features. No other seat (passenger, cabin crew, or flight crew) is requested for relief. Time extent of temporary exemption to be from 5/15/95 until 4/1/96 for production compliance."

"FAA denied Boeing an exemption from the Head Injury Criteria (HIC) per FAR 25.562(c)(5) for front row seats on 1/29/93. Subsequently, after extensive testing and coordination with airlines, Boeing chose Improved Headpath Seats (formerly referred to as Articulating Seats) as the method of compliance with front row seat HIC. This decision was based on Improved Headpath Seats providing greater overall passenger safety than other options. Boeing's compliance proposal was presented to FAA on 8/30/93. Justification for selection of Improved Headpath Seats instead of other solutions was included.

"FAA responded that, because of its novel and unusual nature, this compliance method required design guidance. A draft list of design guidance issues was received by Boeing on 11/18/93. In response, Boeing conducted research and testing to address each issue, culminating in FAA approval of Boeing's compliance proposal on 3/16/94.

"Boeing conducted two Seat Supplier Symposiums, on 9/14/93 and 3/29/94, to inform the suppliers of Boeing's choice of Improved Headpath Seats, provide design details of Boeing's prototype seat, show examples of other designs available, and review final FAA compliance requirements. Suppliers were instructed to begin design, testing, and production of Improved Headpath Seats.

"Since the 3/29/94 Symposium, seat suppliers have actively pursued Improved Headpath Seat designs to meet front row HIC. At the time of this petition, two

suppliers have successfully passed certification tests of first class and business- class seats. One supplier has conducted the first round of certification testing of an economy class seat, with unsuccessful results. Other suppliers are in various phases of design, prototype testing, and production developmental testing. Boeing has provided technical support whenever requested.

"Problems With Improved Headpath Seat design have been encountered. Where seat-to-airplane interior setbacks are relatively large (greater than 40 inches - primarily first and business class seats), suppliers have had success. Where setbacks are smaller (less than 40 inches - primarily economy class seats), suppliers have had difficulty. Problems center on reducing structural deflections of economy class seats, with overhung seat positions (positions cantilevered beyond the seat legs) being the most difficult. Prototypes of seats with nonoverhung positions have been successfully tested. Several design solutions are being pursued in coordination with Boeing and the airlines. However, no supplier has a certifiable production economy class front row seat available at this time.

"Basis for requesting temporary exemption:

"Although significant progress has been made, there is insufficient time for seat suppliers to design, test, and certify Economy Class Improved Headpath Seats prior to initial 777 deliveries.

"Seat suppliers were given final 'go ahead' to develop Improved Headpath Seats at the 3/29/94 Boeing symposium. Until then, FAA compliance requirements were not finalized. This left 13 months until first 777 delivery on 5/15/94. Although Boeing expected all front row seats to be completed in this time, only first class and business class seats will meet all certification requirements including HIC; economy class seats will not. This is due to the unanticipated length of time for suppliers to accomplish the design and testing necessary to achieve shorter headpaths of front row economy class seats. Finding solutions to structural deflection problems has also delayed completion.

"Another factor hindering front row seat progress, is the difficulty the Supplier Industry is experiencing in complying with FAR 25.562 in general. Suppliers are having problems meeting 16g/14g structural, lumbar load, and row-to-row HIC criteria. As a result of failures during certification testing, 2 1/2 times as many tests have been needed than originally planned. Overcoming these problems has delayed seat suppliers from development of Improved Headpath Seats.

"Progress toward certification continues to be made. First class and business class seats will be fully compliant on all 777 deliveries. Boeing had hoped that the front row economy class seats would also be compliant to the rules at the time of initial delivery.

However, economy class seats are still being developmentally tested to find solutions to problems encountered. Boeing is confident that front row economy class seats will be certified within the requested time frame of the temporary exemption.

"More time is necessary for full involvement of the Seat Industry in Improved Headpath Seat design.

"To thoroughly develop Improved Headpath Seat designs, the Seat Industry needs to be fully involved. Currently, only three seat suppliers have progressed to certification testing and only one has tested economy class seats. Because seat suppliers are contracted by the airlines (as Buyer Furnished Equipment), their involvement is determined by Boeing's airplane delivery schedule. By first quarter 1995, seven different supplier programs will be underway for design and certification of economy class front row seats for 777 deliveries through first quarter 1996. This level of Seat Industry involvement will result in development of best design solutions.

"Boeing will work with the airlines to technically support retrofit of delivered airplanes.

"At the time of airplane delivery, Boeing will formally document specific noncompliance if economy class front row seats do not fully meet the rules as outlined in this petition. Boeing will continue to support supplier design, testing, and certification, and will technically support airline retrofit of compliant solutions on delivered airplanes.

"Justification of requested temporary exemption dates:

"Boeing requests the temporary exemption to commence on 5/15/95, the date of delivery for the first 777. Production incorporation of compliant solutions is requested on all deliveries after 4/l/96. This is chosen to allow enough time for all seven active economy class seat programs to complete certification of Improved Headpath Seats prior to the compliance date. Retrofit is suggested to commence no sooner than six months after production compliance. It is anticipated that six months will be required for preparation and FAA approval of retrofit data that may be required.

"Until compliant Improved Headpath Economy Class Seats are developed, Boeing believes FAA should not mandate other front row HIC solutions. Short pitching seats, restricting recline, and removing seats all place a severe competitive and economic burden on the airlines. These solutions also put the 777 airplane at a disadvantage with respect to competitors who do not have this rule in their certification basis. Mandating other design options, such as airbags or shoulder harnesses is also not desirable because development of these options would further delay the date of compliance.

"Reasons why granting a temporary exemption is in the public's interest and will not adversely affect public safety:

"Granting a temporary exemption will allow the 777 airplane to operate at its full capability and meet the contracted requirements of the airlines. This, in turn, is in the interest of the traveling public. Conversely, denial of a temporary exemption would cause operation of the airplane at less than full capability and create an economic burden on the airlines and the public.

"Granting a temporary exemption will not impede development of Improved Headpath Seats as the compliance means for FAR 25.562(c)(5). Suppliers will continue to develop, test, and certify these seats. Boeing will continue to provide technical support as needed and will assist airlines with retrofit of delivered airplanes.

"Public safety will not be adversely affected. [The Model] 777 front row economy class seats will meet the same safety standards, for head injury avoidance, now met by all other large transport aircraft being currently certified for delivery. In fact, the 777 will be the first large transport airplane to meet the higher HIC safety standard for front row first class and business class seats.

"The overall time frame and number of aircraft are small. By 4/l/96, less than 30 777's should be delivered. The and/on changes to future delivered aircraft combined with the retrofit program will ensure full compliance. Considering the relatively few number of seats affected due to the initial delivery schedule, combined with the extremely remote circumstances of the 16g loads, the overall passenger safety is deemed acceptable.

"Justification of request for exception to publication and comment procedures of FAR 11.27(c) under the provisions of FAR 11.27(j)(3):

"FAA denial of this exemption will require extensive and disruptive changes to contracted interior arrangements. Because of the manufacturing lead times necessary to accomplish such changes, FAA's decision is urgently needed to avoid the detrimental economic impact which Boeing will incur.

"As outlined [earlier in this request], Boeing has worked with the seat manufacturers for resolution of this issue until the last possible date.

"Granting this exemption will not set a precedent in that it is for a time extension from a requirement and not permanent relief from a requirement and, therefore, will not create a public safety issue.

"Similar exemptions have been granted to other manufacturers.

"In conclusion, Boeing feels that the foregoing information substantiates our petition for temporary exemption from FAR 25.562(c)(5) and FAR 25.785(a) for front row economy class seats. We are firmly convinced that Improved Headpath Seats are a viable and desirable means of compliance with front row HIC and allowance of additional time for their full development is in the interest of the traveling public. Boeing will continue to pursue with full effort, the certification of these seats for production incorporation by the compliance date requested and support airline retrofit as needed. We request that you find our petition to be valid and grant a temporary exemption."

A summary of the petitioner's January 25, 1995, petition was published in the Federal Register on February 17, 1995 (60 FR 9422). Two comments were received after the close of the comment period.

One commenter supports the petition, and notes that the issue of front row HIC is a major difficulty in the industry. The commenter notes that this was conveyed to the FAA during an industry meeting in March of this year, and recommends that the FAA grant the petition.

A second commenter does not support the petition, and asserts that Boeing has elected to pursue only one course of action, and that course of action may not be the most efficient means of demonstrating compliance. In addition, the commenter questions whether the proposed method can stand up to wear and tear in service without degrading its performance. The commenter notes that studies carried out on behalf of the Japan Civil Aviation Bureau have shown that an upper torso restraint is an acceptable means of reducing HIC. Finally, the commenter proposes that if no other design solution is available, the front row seats should be positioned sufficiently far from the bulkhead to prevent head contact. The FAA agrees that the design solution chosen by Boeing may not be the most easily adapted to production. However, none of the potential design solutions have yet been adapted for general production use. The study referred to by the commenter was basically a feasibility study to determine whether a passenger seat could be adapted to include an upper torso restraint. The study did not address the affect of the modified seat on an occupant of the seat row behind, and this is generally regarded as the primary difficulty with front row upper torso restraints. The study itself notes that much additional work is necessary before such seats are available for production installation. The issue of increased seat spacing is discussed in the section that follows.

The Federal Aviation Administration's analysis/summary is as follows:

The FAA notes that the petitioner has several reasons for requesting this temporary exemption. In addition to the incomplete development of the preferred solution, the petitioner cites problems in compliance with the basic regulation as additional reasons why an extension should be granted. While it is true that the seat suppliers have conducted more tests than were originally anticipated in order to show compliance with the basic structural portion of the

regulation, this does not have a direct bearing on the lack of available solutions for front row tourist seats. Overall industry experience indicates that the basic structural problems can be, and have been, solved by a number of manufacturers. While the choice of an "improved headpath seat" may contribute to the difficulty of compliance, this is a consequence of the design solution chosen, and not an inherent difficulty of the regulation.

In addition, the petitioner also notes that the participation of the full seat industry is necessary in order to bring the improved headpath seat concept into practical design solutions. While the FAA agrees that full participation of the industry is desirable, and probably a more efficient way to approach the problem, this also does not support the request for exemption. In fact, it is the petitioner's responsibility to show compliance, regardless of the contractual arrangements between seat supplier and airline customer. The fact that a limited number of suppliers are initially supporting the delivery of the 777 simply means that more of the direct responsibility for an acceptable design might have to be assumed by the petitioner. The FAA notes that Boeing intends to become more involved in the process, and encourages this development.

Boeing also notes that final certification criteria were still being developed up to March of 1993, and that suppliers were not able to start design until then. While the FAA agrees that final acceptance of the criteria did not occur until then, the basic principles were agreed to some five months earlier, and the intervening time was taken up in the conduct of research and testing to address the initial FAA comments.

Nonetheless, Boeing has made an aggressive, if belated, effort to address the problem of front row HIC, and it is true that other manufacturers have been granted temporary exemptions from the requirement while design solutions are developed. In fact, no manufacturer has yet achieved compliance at all front row locations. In this regard, the 777 will have a higher degree of compliance due to the favorable results with first and business class seats.

Because the improved headpath seats rely on a combination of seat design and interior arrangement to demonstrate compliance, first class and business class seats are not affected by this petition. Similarly, certain economy class arrangements could also prove to be acceptable, depending upon the particular seat supplier, and the amount of space between the forward row and the interior feature. Specifically, if additional space (greater than 35 inches) were provided behind interior walls, a seat that had not demonstrated the full reduction in headpath could be used. This could create the situation where one airline's arrangement would comply with the rule, while another airline's would not. In a supplemental comment to the docket, Boeing has addressed this issue, and indicated that there is no intention to achieve compliance in this manner, as a long term solution. They contend that any such arrangements have been created in order to avoid delivery problems in the absence of a grant of this petition. These arrangements result in a reduction of seat pitch for several seat rows, which is considered an unacceptable economic penalty.

The FAA agrees that simply providing additional space behind interior walls is a solution to the front row HIC problem, with or without the improved headpath seats. The difference would be in the amount of extra space required. It is understood that the overall objective is to maintain the traditional 35 inch setback; however, as in the case with first and business class seats, there may also be arrangements that do incorporate more than this amount. In such cases, the FAA expects that compliance would be shown to the maximum extent possible. Given that the design solutions that do not adversely affect the economics of the interior arrangement have not yet been refined for installation, the FAA is not forcing compliance by removing seats or reducing seat pitch at this time. Should these become the only viable means of compliance (which is not expected to be the case) the FAA will consider such measures at that time.

Nonetheless, there is a combination of seat design and interior arrangement that is acceptable for front row tourist class passenger seats. This arrangement corresponds to the first US customer for the airplane, and is consistent with arrangements on similar class airplanes. The seats in question have demonstrated compliance with all aspects of the rule, for the installed configuration. While this may not be the design solution that is desired for the long term, it is compatible with the current market needs, and it is expected that development of the preferred solution will occur to support subsequent requested changes in the interior. Therefore, since the US fleet would not require an exemption, the FAA has determined that a general exemption for the aircraft type is not appropriate.

The airplanes affected by other exemptions are predominantly small, turbo-prop airplanes, where the restrictions on interior design are quite severe. That is, there is not the interior configuration flexibility to increase the spacing behind a bulkhead to the extent necessary to comply, without loss of seats. For this class of airplane, loss of a single seat row would represent approximately ten percent of the available seating capacity; thus, front row HIC is a more severe problem for these airplanes. The FAA notes that manufacturers of these airplanes have been very involved in developing long-term solutions to front row HIC, and have very aggressive programs in place for the development of both upper torso restraints and airbags.

In consideration of the foregoing, I find that a grant of exemption is not in the public interest. Therefore, pursuant to the authority contained in §§ 313(a) and 601(c) of the Federal Aviation Act of 1958, delegated to me by the Administrator (14 CFR 11.53), the petition of Boeing Commercial Airplane Group for exemption from the HIC requirements of § 25.562(c)(5) of the FAR, for front row seats on Boeing 777-200 airplanes, is hereby denied.

Issued in Renton, Washington, on August 22, 1995.

/s/ Darrell M. Pederson, Acting Manager
Transport Airplane Directorate
Aircraft Certification Service